



**Aviation Life Support Equipment Retrieval Program:  
Report of Aircraft Mishap 95-4, Involving the  
HGU-56/P Army Aviation Helmet**

by

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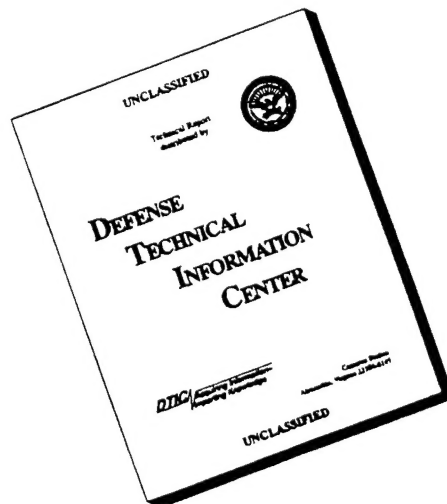
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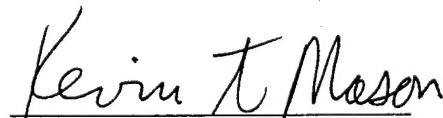
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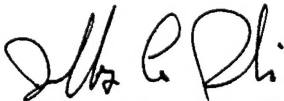
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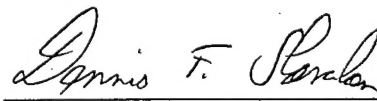


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## Introduction

In 1972, the U.S. Army Aeromedical Research Laboratory (USAARL) established the Aviation Life Support Equipment Retrieval Program (ALSERP). The purpose of this program is to evaluate the effectiveness of aviation protective equipment in an aircraft accident environment and to contribute to the improvement of this equipment through modification or development of new design criteria. Department of the Army Pamphlet 385-40, Army Accident Investigation and Reporting, requires all life support equipment which is in any way implicated in the cause or prevention of injury be shipped to USAARL for analysis (DA Pam, 1994). This report analyzes the first impact-damaged HGU-56/P recovered from a Class B aviation mishap involving an AH-6J that occurred on 20 April 1995.

Reducing the incidence of head trauma and basilar skull fracture has been a focal point for Army aviator helmet research and development through the years. Pilots are injured from blows they receive when they flail into intruding objects and collapsing aircraft structure while experiencing crash dynamics. Further, head injuries have been identified as the most common cause of death in helicopter accidents (Shanahan, 1985). The evolutionary process of designing and fielding helmets that provide better crash force attenuation to the head resulted in the Army fielding the SPH-4 in 1970, the SPH-4B in 1991, and the HGU-56/P in 1995 (Table 1). Each of these helmets incorporate incremental improvements designed or intended to reduce or prevent injury.

Table 1.  
U.S. Army flight helmet comparison.

Component	SPH-4 - 1970	SPH-4 Mod 1978 - 1985	SPH-4B 1991	HGU-56/P 1995
Helmet weight (lb)	3.4	3.4	2.8	2.6
Shell material	Fiberglass cloth	Fiberglass cloth	Kevlar™ cloth layers	Nylon and graphite cloth
Liner thickness (in)	.38	.50	.60	.70
Suspension system	Three strap sling	Thermoplastic liner (TPL™)	TPL™	TPL™
Earcup type	Rigid plastic	Rigid plastic	Crushable plastic	Crushable plastic
Visor type	Single, acrylic	Single, polycarbonate	Dual, polycarbonate	Dual, polycarbonate
Impact protection*	~ 300-350g	~ 225-275g	~ 200-225g	~ 120-180g

\* Acceleration transmitted to the head - lower values indicate improved performance.

## Background

### Accident overview

The aircrew members were conducting mountain flying operations at the time of the mishap. While climbing to negotiate a 11,312' mean sea level (MSL) mountain pass, at approximately 200' above ground level (AGL) and less than 40 knots of forward airspeed, the pilot in command, after determining that the aircraft would not clear the pass, began a right turn to abort the maneuver. While in the right turn the aircraft lost altitude rapidly and settled into the trees. During the crash sequence, the aircraft lost the tail rotor, tail boom, and portions of the main rotor blades. The fuselage impacted the snow-covered ground on the right side, coming to rest approximately 70 feet from the first main rotor point of impact (Fig. 1). The copilot egressed the left seat immediately. Due to cockpit deformation, the pilot in command was initially entangled by the instrument panel but was able to free himself and egress the right front seat. Both pilots sustained minor injuries and were rescued 2 hours and 50 minutes later by a civil rescue squad. The ALSERP team analyzed the data recorded on the DA FORM 2397 series, Technical Report of U.S. Army Aircraft Accident, and performed a laboratory evaluation of the HGU-56/P belonging to the pilot in command.

## Kinematics

The aircraft first came in contact with the trees at a forward speed of approximately 12 knots, in a right 30-degree roll, with the nose pitched down 10 degrees, descending at approximately 500 feet/minute. The flight path and impact angle was 57 degrees down. The aircraft sustained major damage to its right side as it descended through the trees impacting the ground at 9 Gs. The aircraft yawed 75 degrees from the initial impact heading and came to rest on its right side. Because the livable space was not compromised and the crash forces were within human tolerance, the crash was deemed survivable.

## Personal injuries

The copilot sprained his left knee and bruised his right ribs. The pilot in command received a stress injury to his right elbow and a laceration and contusion to his right chin. It was reported that injuries resulted from excessive loading and flailing during the crash sequence. It is not known whether the pilot in command's facial injuries resulted from impact with intruding objects (such as a tree limbs), or if he flailed into aircraft structure.

## Analysis and discussion

### The HGU-56/P

Both occupants were wearing the new HGU-56/P Army aviation helmet. The copilot's helmet was undamaged in the mishap. The ALSERP team analyzed the damaged HGU-56/P worn by the pilot in command in accordance with USAARL Policy No. 95-55 (1985). This impact, from an undetermined type of surface, caused a 3½-inch complete shell fracture on the eardome from front to rear and a 1-inch horizontal hairline fracture on the same eardome from rear to front (Figs. 2- 3). A complete tear down and inspection revealed no other damage. The energy-attenuating earcup did not exhibit markings indicative of deformation. Therefore, it is not likely that the earcup was exposed to significant impact forces.

## Conclusions

The first HGU-56/P recovered from a mishap provided adequate protection to the crewmember. The helmet was retained on the wearer's head indicating proper fit and function of the retention assembly. Although it was rendered unserviceable in the mishap from a sharp blow to the bottom right eardome, the impact forces were not transmitted to the pilot's head. The facial laceration and contusion to the pilot's chin are not attributable to the HGU-56/P. The energy-attenuating earcups did not appear to have been exposed to significant impact. The crash forces encountered in this mishap did not cause the protective capabilities of this helmet to be fully challenged.



### References

Department of the Army. 1994. Army accident investigation and reporting. Washington, DC: Department of the Army Pamphlet 385-40. 1 November.

Shanahan, Dennis F. 1985. Basilar skull fracture in U.S. Army aircraft accidents. Fort Rucker, AL: U.S. Army Aeromedical Research Laboratory. USAARL Report No. 85-11.

U.S. Army Aeromedical Research Laboratory. 1995. Aviation Life Support Equipment Retrieval Program. USAARL Policy No. 95-55. 3 February.



Figure 1. The AH-6J at the crash site.

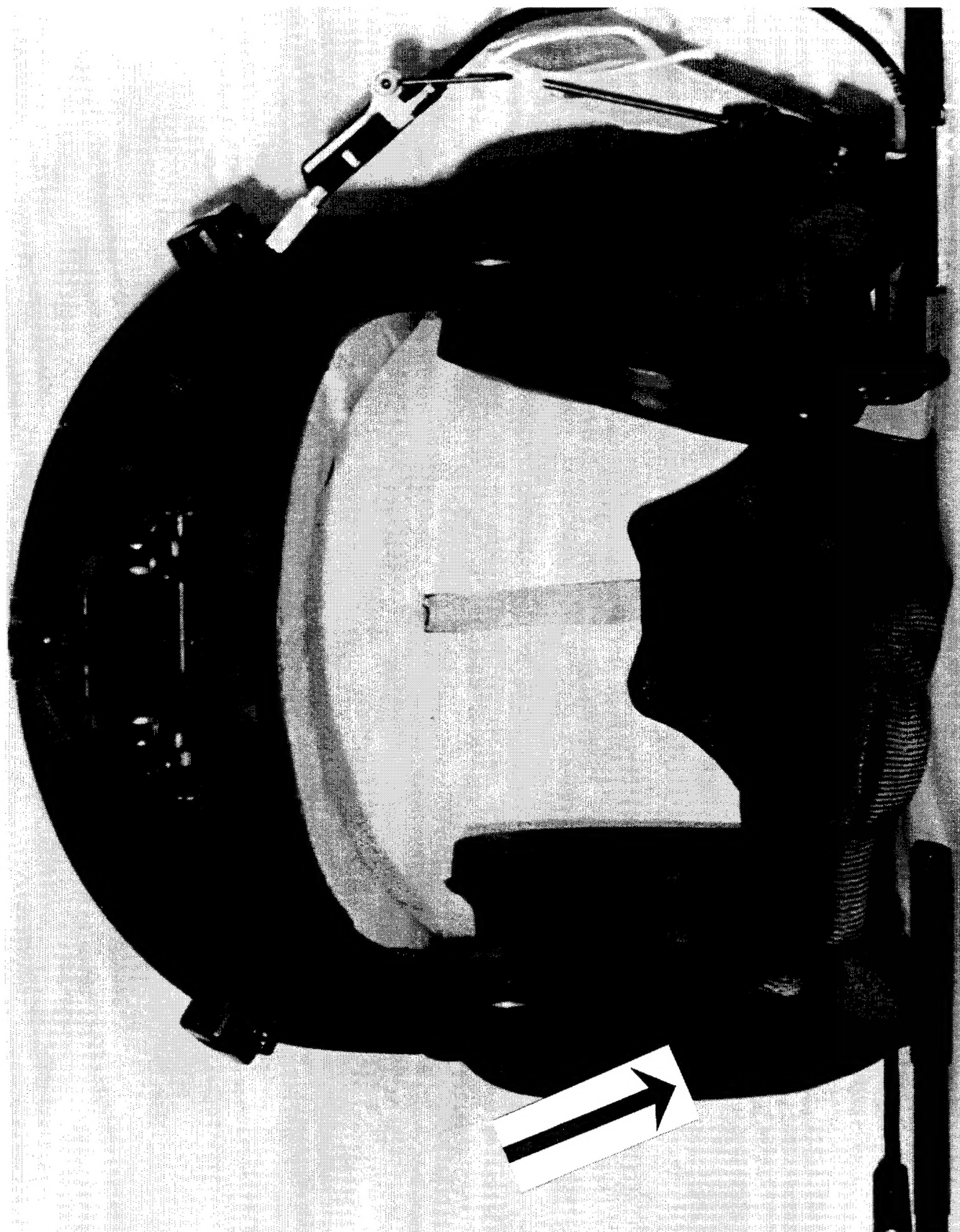


Figure 2. The damaged HGU-56/P Army aviation helmet.



Figure 3. The impact to the right eardome was sufficient to completely fracture the helmet.